I. Two Types of Skepticism

Metaphysical skepticism = Skepticism about claims that go beyond all possible evidence.

Arises whenever there are two or more possible ways of describing the world and no possible evidence is sufficient to determine which is true.

Example: “We are brains in vats.”

Inductive skepticism = Skepticism about claims about the world that go beyond the currently available evidence.

Arises whenever there are two or more possible ways of describing the world and no evidence currently available is sufficient to determine which is true.

Example: “All ravens are black”.

Note: In the terms of a previous lecture, metaphysical skepticism is skepticism about theoretical claims (in-principle unobservable claims); inductive skepticism is skepticism about in-principle observational claims.

II. Kant’s Proposal (1787) Critique of Pure Reason

(1) Response to metaphysical skepticism: Argue that we should not be concerned with claims that go beyond all possible experience. Make the following distinction:

Things-in-Themselves (Noumenal World)

no knowledge possible

World of Experience (Phenomenal World)

object of knowledge

Noumenal world:
• raw data
• cannot be directly experienced.

Experience:
• act of filtering/processing raw data
• dependent on "built-in" intrinsic "filters"

Phenomenal world:
• product of experience
• conditioned by the way we process/filter the raw data

Claim: Metaphysical skepticism is generated by claims about the noumenal world (claims that go beyond all possible experience). Thus it is untroublesome -- such claims are not the proper objects for knowledge.
Response to inductive skepticism: Recall Hume's two assumptions:

(a) (Empiricist Claim) Matters of fact are known only through experience.
(b) To know means knowing with certainty that you know.

Kant rejects (a). He does this by distinguishing between four types of claims:

Four Types of Statements (according to Kant):

1. **analytic:** - logical truth or definition
   - negation entails contradiction
   - devoid of factual content
   True by definition; true by virtue of the meaning of the terms that appear in it.
   Ex: All ravens are either black or not black.

2. **synthetic:** - contingent (i.e., could be either true or false)
   - negation does not entail contradiction
   - contains factual content
   In the sense of ruling out certain possibilities; i.e., not true in all possible worlds
   Ex: All ravens are black.

3. **a priori:** - truth/falsity can be established without recourse to experience

4. **a posteriori:** - truth/falsity can only be established by recourse to experience

(1) and (2) are mutually exclusive (a claim can’t be both analytic and synthetic at the same time). Likewise, (3) and (4) are mutually exclusive.

Recall: Hume only distinguishes two types - Relations of Ideas vs. Matters of Fact.

Here’s how they relate to Kant’s distinctions:

<table>
<thead>
<tr>
<th></th>
<th>a priori</th>
<th>a posteriori</th>
</tr>
</thead>
<tbody>
<tr>
<td>analytic</td>
<td>Relations of Ideas</td>
<td>Matters of Fact</td>
</tr>
<tr>
<td>synthetic</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

This cell is empty. All analytic claims are a priori - their truth is established by logical considerations alone

Matters of Fact are synthetic claims that are a posteriori - “All ravens are black” can’t be known through reason alone.

Are there synthetic a priori claims?

Kant’s Claim: “Yes”.

Ex: 7 + 5 = 12. Kant argues that this statement is certain, but is not based on experience (so it is a priori). But it is not analytic: The concept of “12” is not contained in the concepts of “7” and “5”. In this sense, the negation of “7 + 5 = 12” does not entail a contradiction. Hence, in addition to being a priori, it is also synthetic; i.e., it is a synthetic a priori truth.
**Synthetic a priori truths**: True claims about the world knowable through reason alone.

### Three of Kant’s examples:

1. Every event has a cause.
2. Statements in Euclidean geometry.
3. Statements in arithmetic.

### Claim:
Forms of "intuition" and "understanding" are necessary in order for knowledge and experience to be possible. Such forms are preconditions for the possibility of knowledge and experience.

**ASIDE**: In other words, Kant claims that Euclidean geometry and arithmetic must be true of the world, because they preconfigure the way we experience the world. One way to think about this is the following: According to Kant, the phenomenal world is literally constructed by us. It is the result of processing the raw data of experience (associated with the unknowable noumenal world) into a general Form that we can comprehend. This Form depends exactly on the way the data gets processed by us; it is prefigured by how we process data. And there are a number of ways we process data. Kant calls these ways pure forms of intuition (which prefigure our senses; he identifies 2: Euclidean geometry and arithmetic) and pure forms of understanding (which prefigure how we analyze the data from our senses; he calls these “categories” and identifies 12 including the concept of causality listed above).

So: The general Form our experience takes (the phenomenal world) is the result of a number of sub-forms working in conjunction. Again, these prefiguring forms include the notion of causality, and Euclidean geometry and arithmetic.

### Summary:

1. Knowledge has both a **form**, which is conceptual and mind-dependent, and a **content**, which is contributed by the world.
2. The formal aspect consists of unrevisable *synthetic a priori* truths.
3. These truths include, among other things, Euclidean geometry, arithmetic, and the claim that all events have a cause.

**ASIDE**: One can disagree with Kant on any or all of these points. Kant’s argument for Claim (2) is known as the transcendental deduction. He thought Claim (2) was an a priori truth. Kant’s argument for Claim (3) is known as the metaphysical deduction.

So: Kant rejects Hume’s assumption (a).

But: Kant still retains assumption (b).

Ex: Kant thought the hypothesis \( H = \) “All objects are infinitely divisible” is unknowable because it cannot be *verified with certainty* (which is the criterion Hume adopts in assumption (b)). The Demon and the Banana example indicates why \( H \) cannot be known with certainty: No matter how many cuts you make, you will never know with certainty that the next cut of the banana will succeed (the demon may decide then and there to thwart your attempt).

**ASIDE**: As indicated earlier, there are weaker notions of justification than *verification with certainty*. For example, you could maintain that to be justified in believing a claim, it must have been produced by a method that is reliable in the limit (at some point after umpteen many pieces of evidence, it has to converge to the truth). One can show that Kant’s \( H \) is refutable in the limit; hence, on this notion of justification, we can have knowledge that it is false.)
The Demise of Kant’s Proposal

Kant’s claim that there are synthetic a priori truths has been questioned. Some take the following two historical developments of the late 19th/early 20th century to show that his examples from Euclidean geometry and arithmetic fail.

(1) The development of non-Euclidean geometry.

Non-Euclidean geometries indicate that Euclidean geometry is not a necessary precondition for describing the physical world. This introduces a distinction between:

(a) **pure geometry**: consists of analytic a priori statements.

(b) **applied geometry**: consists of synthetic a posteriori statement.

This distinction arises because we now have a choice (Euclidean vs. non-Euclidean) of descriptions, and which description really holds is an empirical matter; it cannot be decided based on pure reason alone.

*Note:* The claim that nevertheless human perception is based on Euclidean geometry does not defuse this objection to Kant (someone might observe that Euclidean geometry is no longer a necessary precondition for describing the world, but it still is a precondition for experiencing the world). The mere logical possibility of alternatives to Euclidean geometry is enough to question his claim that the latter contains synthetic a priori truths.

**Aside:** Euclidean geometry can be axiomatized. The standard scheme includes the postulate:

(1) **Euclidean 5th postulate:** “Through any given point only one line can be drawn parallel to a given line.”*

You get a non-Euclidean geometry by tweaking this 5th postulate and leaving all the other axioms alone. There are two basic types of non-Euclidean geometry, depending on the tweaking:

(2) **Spherical geometry 5th postulate:** “Through any given point no lines can be drawn parallel to a given line”.

(3) **Hyperbolic geometry 5th postulate:** “Through any given point infinitely many lines can be drawn that are parallel to a given line”.

---

*This is actually a consequence of Euclid’s 5th postulate.*
The development of modern axiomatic numerical analysis and modern logic.

Indicates that statements in arithmetic can be considered analytic a priori (as opposed to synthetic a priori). In general, allows a distinction between applied arithmetic vs pure arithmetic similar to the one in geometry.

Aside: The philosopher Michael Friedman views the development of modern logic and analysis as a foil to Kant in the following way: Kant only had Aristotelian logic available to him, which does not provide the concepts of infinity and continuity that underlie numerical analysis. Thus, such concepts must be intuitive for Kant. The development of modern logic and analysis in the late 19th and early 20th centuries demonstrated that such concepts need not be left to the intuition, but can be given rigorous formulations.

III. Logical Positivism

School of thought in 1920’s-30’s associated (primarily) with philosophers in Vienna and Berlin

Characterisitcs:

(a) Logical analysis of science.
(b) Empirical (positivist) basis for scientific knowledge.

“positivism” from August Comte (19th cent.) - Claim: sense experience is the basis for knowledge

4 Logical Positivist Attempts to Address Metaphysical Skepticism:

(1) Logical Constructivism

Russell (1918) Logical Atomism, Carnap (1928) The Logical Structure of the World

- Reduce experience (sense-data) to logical constructions (atomic propositions)
- Replace Kant's Phenomenal World with a logical construction.

Result: A logical basis for all meaningful claims about the world.

\[
\text{sense datum } = \text{ atomic proposition} \\
\text{unit of experience} \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \text{linguistic unit}
\]

Translation of world of experience into a logical system (a “language”)

Russell’s Dictum: “Whenever possible, logical constructions are to be substituted for inferred entities.”

Consequence: Resolution of metaphysical skepticism! Claims that go beyond all possible evidence are claims about “inferred entities”. The goal of logical constructivism is to reduce such “metaphysical” claims to logical relations between claims that can be adjudicated by the available evidence (i.e., observational claims).

Aside: Russell’s version adopts phenomenalism -- the emphasis is on immediate sense-data.

Problem: How can an objective world of experience be founded on immediate personal subjective experience? Because of this problem, Carnap’s version drops phenomenalism for physicalism -- the basic terms in the language refer to “middle-sized” objects (not immediate sense-data).
Not all meaningful concepts can be reduced to logical constructions.

Typical example: The logical reconstruction of numbers using set theory faced “Russell’s Paradox”.

How to define numbers using sets:
Let 0 be the empty set (i.e., the set with no members): $0 = \{ \}$ or $\emptyset$.
Let 1 be the set with exactly one member; namely the empty set: $1 = \{ \emptyset \} = \{0\}$
Let 2 be the set with exactly two members: $2 = \{\emptyset, \{\emptyset\}\} = \{0, 1\}$
3 = $\{\emptyset, \{\emptyset\}, \{\emptyset, \{\emptyset\}\}\} = \{0, 1, 2\}$
4 = $\{\emptyset, \{\emptyset\}, \{\emptyset, \{\emptyset\}\}, \{\emptyset, \{\emptyset\}\}, \{\emptyset, \{\emptyset\}\}, \{\emptyset, \{\emptyset\}\}\} = \{0, 1, 2, 3\}$

But: Without any constraints on what counts as a set, there should be sets that do not belong to themselves:
- The set of all cats
- The set $\{0, 1, 2, 3\}$
- The set $\{0, 1, 2, 3, \{0, 1\}\}$
- The set $x = \{a, b, c\}$
And there should be sets that do belong to themselves:
- The set of sets
- The set of all non-cats
- The set $y = \{a, b, c, y\}$

Russell’s Paradox
Let $R$ be the set of all sets that do not belong to themselves.

Claim: $R$ belongs to itself if and only if $R$ does not belong to itself.

Proof: (i) Suppose $R$ belongs to $R$.
Then $R$ is a set that does not belong to itself.
So $R$ does not belong to $R$.
(ii) Suppose $R$ does not belong to $R$.
Then $R$ is a set that belongs to itself.
So $R$ does belong to $R$.

ASIDE: Russell’s solution was to claim that sets of sets are different types of objects than sets.
(2) **Verifiability Principle of Meaning (VPM)**  
Schlick –1920’s

A claim is meaningful if and only if it can be **verified** (i.e., if and only if a set of observations exists that would establish the truth of the claim).

**Consequence:** Metaphysical claims about in-principle unobservable objects are *meaningless.*

This dissolves the problem of metaphysical skepticism given we adopt:

**Assumption:** *Meaningless claims are not objects of belief*

**Important Point:** Metaphysical skepticism is a concern with criteria for belief (it is an *epistemological* concern). It asks: *Do we have any reasons for believing all the claims of a description of the world that goes beyond all possible evidence?* The Verifiability Principle of Meaning is a *linguistic* principle. The above assumption is the link between the epistemological concern and the linguistic principle.

**ASIDE:** It’s important to distinguish between two types of question:

(A) Are the claims a theory makes *believable?* (i.e., Are they well-confirmed? Should we believe them?)

(B) Are the claims a theory makes *meaningful?* (i.e., Are the actual sentences the claims of the theory is expressed in, and the terms that appear in these sentences, meaningful?)

Question (A) is *epistemological.* Question (B) is *linguistic.* One legacy of logical positivism is this link between linguistic concerns and epistemological concerns.

**Main Problem with VPM:** It’s too strict. No scientific claim is verifiable in the sense that its truth can be conclusively established on the basis of observation alone. Thus a strict application of VPM would result in all of science being deemed meaningless.

(3) **Meaning Postulates**  
Carnap (1936) *Testability & Meaning*

Attempt to demonstrate how terms in a theory acquire their meanings (i.e., by means of "meaning postulates"), and hence how claims incorporating such terms acquire credibility.

**Motivation:** We can reject the VPM as too strict, but still retain the assumption that meaningless claims are not objects for belief. Then, in order to demonstrate what sorts of claims are believable and what aren’t, we need to be able to determine what sorts of claims are *meaningful* and what aren’t. To do this, we need to know how the sentences and terms in a theory are given their meanings.
How terms in a theory acquire meaning (Carnap’s method):

(a) First distinguish between:
   (i) **Observational terms** = terms that refer to in-principle observable objects.
   (ii) **Theoretical terms** = terms that refer to in-principle unobservable objects.

(b) Now claim:
   (i) Observational terms acquire their meaning directly through experience.
   (ii) Theoretical terms acquire their meaning by translating them into observational terms.

_**Meaning postulate**_ = A sentence that contains both observational terms and theoretical terms and acts as a translation rule that establishes the meaning of a theoretical term by linking it directly with one or more observational terms.

**Two characteristics of Meaning Postulates:**

(1) A meaning postulate is an analytic sentence: It is true by definition.

(2) Meaning postulates play two roles:
   (i) They establish the **meaning** of theoretical terms.
   (ii) They allow Instance Confirmation to be extended from purely observational hypotheses to purely theoretical hypotheses.

_Aside:_ Recall that under Instance Confirmation, _E_ confirms _H_ just when _E_ is an instance of, or entails an instance of, _H_. _E must_ be an observation sentence (only containing observational terms). If _H_ is an observation sentence, then it can share some of its terms with _E_, hence we can see how _E_ might entail an instance of it. However, if _H_ is a purely theoretical sentence, it can _never_ share any terms in common with any _E_; so the instance confirmation account fails for such _H_’s. Meaning postulates fill this gap — they allow purely theoretical sentences _H_ to be linked with purely observational sentences; hence they allow the possibility of instances of a purely theoretical _H_ to be entailed by a purely observational _E_.

**Meaning postulates as operational definitions**  Bridgeman (1937) _The Logic of Modern Physics_

An operational definition defines a term by linking it to a series of operations and observable outcomes that must occur in order for the term to be applicable.

**Ex1:** Operational definition of _soluable in water_:

“_x_ is soluable in water” means “If _x_ is placed in water, then _x_ dissolves”

**Ex2:** Operational definition of _simultaneity_:

“Events _A_ and _B_ are simultaneous” means “If light signals are emitted from _A_ to _B_ and _B_ to _A_, then they will be received at an event half-way between _A_ and _B_ at the same time”
Problems with operational definitions:

(a) One definition per measuring device/operation.

(b) Some terms cannot be equated with observable outcomes of operations (Isn’t there more to “pain” than the sum of its effects?) The Anesthetized Baby Parable.

(c) Anything that does not satisfy the "if" clause of the definition satisfies the definition! (In Ex1, the conditional is true of any x that is never placed in water; so according to the definition, any x that is never placed in water is soluable in water!)

Ex3: Operational definition of a mental state (pain):

“x is in pain” means “If x is brought into contact with certain stimuli, then certain movements of x’s bodily extremities are observed, accompanied by high-frequency vocal emissions”

ASIDE: Operational definitions are a particular type of explicit definition in which a theoretical term is explicitly defined by reference to observational terms. Explicit definitions take the following general form:

\[ Cx \leftrightarrow (Sx \rightarrow Rx) \]

"x is an instance of C if and only if, if x satisfies the test condition S, then x is an instance of R", where C is the theoretical term to be defined, S is an observational term describing a test condition, and R is an observational term describing an outcome of the test. Carnap originally suggested using what he called "bilateral reduction sentences" as meaning postulates. They take the following general form:

\[ Sx \rightarrow (Cx \leftrightarrow Rx) \]

"If a case of x satisfies the test condition S, then x is an instance of C if and only if x is an instance of R". Bilateral reduction sentences don't face problem (c) above; but problems (a) and (b) are still present. In more general accounts, a meaning postulate can be any sort of generalization. The idea is to treat some subclass of generalizations in a theory as meaning postulates: relations between observational and theoretical terms that are stipulated as definitions and not subject to confirmation/disconfirmation (i.e., they are treated as analytic).

(4) Conventionalism

Reichenbach (1938) Experience and Prediction

Given two hypotheses that agree on all possible evidence but disagree on their claims, the choice between them is made by convention. There is no fact of the matter which is true.

Motivation: Refocus concern on believability (confirmation) as opposed to meaning.

ASIDE: One way to think of conventionalism is by comparing it with Kant. Recall that Kant held a form/content distinction in describing knowledge. For Kant, the formal element was unreviseable and inherent in all rational beings. The conventionalist can be seen as observing that the formal element, if it does exist, is not unreviseable -- there are many ways we can put structure and form on the content of our experience; any one particular way is adopted by convention.
**Example: The Conventionality of Simultaneity**

**Claim:** The choice of a simultaneity relation to describe the simultaneity of distant events at rest with respect to each other is *conventional*. Given an event $A$, there is no objective fact of the matter as to what distant events at rest with respect to $A$ are simultaneous with $A$.

**Aside:** According to special relativity, the simultaneity of events in constant motion with respect to each other (*i.e.*, in different inertial frames) is *relative*, and thus non-absolute (this is the *relativity* of simultaneity). The *conventionality* of simultaneity claims that simultaneity is non-absolute for events in the *same* inertial frame, too.

**Question:** How can the simultaneity of distant events be established?

Einstein (1905): By setting up synchronized clocks at these events.

**Question:** How can distant clocks be synchronized?

Einstein (1905): Use light signals.

**Operational Procedure for Clock Synchronization**

1. Emit a light signal from Clock $A$ to Clock $B$ and record the time $T_{A\text{-emit}}$ on Clock $A$.
2. Have Clock $B$ reflect the signal back to Clock $A$. Record the Clock $B$ time $T_{B\text{-reflect}}$.
3. Record the Clock $A$ time $T_{A\text{-return}}$ when the light signal returns.

Clocks $A$ and $B$ are stipulated to be in synchrony just when

$$T_{B\text{-reflect}} = T_{\frac{\epsilon}{2}} = T_{A\text{-emit}} + \frac{\epsilon}{2}(T_{A\text{-return}} - T_{A\text{-emit}})$$

**Standard Definition of Simultaneity**

The event at $T_{B\text{-reflect}}$ is simultaneous with the event at $T_{\frac{\epsilon}{2}} = T_{A\text{-emit}} + \frac{\epsilon}{2}(T_{A\text{-return}} - T_{A\text{-emit}})$.

**Claim:** The standard definition is *conventional*. We could also stipulate that Clocks $A$ and $B$ are in synchrony just when

$$T_{B\text{-reflect}} = T_{\frac{\epsilon}{2}} = T_{A\text{-emit}} + \epsilon(T_{A\text{-return}} - T_{A\text{-emit}}), \quad 0 < \epsilon < 1$$

**Non-Standard Definition of Simultaneity**

The event at $T_{B\text{-reflect}}$ is simultaneous with the event at $T_{\frac{\epsilon}{2}}$. 
Note: There are an infinite number of non-standard definitions! One for every value of $\varepsilon$ between 0 and 1. The standard definition is obtained by setting $\varepsilon = 1/2$. The conventionalist claims that we choose the value of $\varepsilon$ by convention.

Why? Why isn't there a fact of the matter what the value of $\varepsilon$ should be? Key assumption of Einstein's $\varepsilon = 1/2$ "choice": The light signal travels at the same speed from Clock A to Clock B as it does from Clock B back to Clock A.

**Notice:** If we choose the $T_\varepsilon$ event in the diagram as simultaneous with the $T_{B-reflect}$ event, this entails that, according to Clock A, the light signal takes more time to travel from A to B than it does to travel from B back to A. But the distance traveled is the same in both directions. So the light signal's speed must be slower outward-bound than inward-bound.

**And now the catch:** In order to measure the speed of light from point A to point B, say (the "one-way" speed of light), we first need to have synchronized clocks set up at A and B.

**Note:** The round-trip speed of light is unproblematic. You just need one clock to measure it.

**Problem of Circularity:**
(a) To measure the one-way speed of light, we need synchronized clocks.
(b) But we can only synchronize our clocks if we have prior knowledge of distant simultaneity, which requires prior knowledge of the one-way speed of light.

**Upshot:** An Infinite Number of Competing Hypotheses that Agree on All Possible Evidence:
Every value of $\varepsilon$ between 0 and 1 represents a particular claim about the nature of simultaneity. All values agree on all possible evidence. The conventionalist says we pick one such value as a matter of convention.